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Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-77-17

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Big Sioux Conifer Nursery

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INTRODUCTION

Soilborne diseases in nurseries caused by species of Pythium and Fusarium can cause intolerable losses. In September 1977, soil samples were taken at the South Dakota State Division of Forestry Big Sioux Conifer Nursery, Watertown, S. D., in order to determine the relative numbers and distribution of the fungi in the soil. Samples will be taken at the same locations in the spring of 1978 before sowing and disease incidence will be compared with fungal propagules per gram of soil. The goal is to determine the levels of fungi at which loss may occur and provide guidelines for control when necessary.

TECHNICAL INFORMATION

CAUSAL AGENTS: *Pythium* spp., damping-off
Fusarium spp., causes both damping-off and Fusarium root disease

HOSTS AFFECTED: Most conifer species except juniper

CAUSAL AGENT BIOLOGY: Pythium and Fusarium are native to nursery soils and survive as "propagules" (spores: oospores or sporangia for Pythium, chlamydospores for Fusarium). When in contact with host tissue, the propagules germinate. Pythium and Fusarium may infect the radicle before the seedling emerges resulting in pre-emergence damping-off, or they may attack the young seedling after emergence at or just below ground level causing the seedling to fall over (postemergence damping-off).

Fusarium root disease occurs later in seedling development than damping-off. The fungus grows on the root surface and then invades the cortex and xylem, eventually killing the seedling.

METHODS

Soil samples were taken with a 2 cm diameter soil probe in three beds that will be sown with ponderosa pine in the spring of 1978. These

beds will be used for the Abbott-Pisolithus Nursery Testing Program (see map). The objective of this nationwide pilot test is to evaluate the effectiveness of a commercially-produced mycorrhizal inoculum for increasing survival and growth of conifers in nurseries and outplanting sites.

Soil samples were taken at three depths: A, 0-5 cm; B, 12.5-17.5 cm; and C, 25-30 cm. There were five 130-foot-long plots in the 3 beds, and in each plot 9 samples were taken, 3 at each depth. The original plan was to fumigate with pressurized 2 lb. cans of Dowfume® MC-2 (98% methylbromide, 2% chloropicrin) in the fall of 1977; therefore pre-fumigation samples were taken at 3 locations:

1. directly under fumigant release locations (center of bed, see map)
2. center of bed between fumigant release locations
3. edge of bed between fumigant release locations

In each of the five 130-foot-long plots, a randomly selected soil sample was taken at each of the 3 depths at each of the 3 locations. (3 x 3 = 9 samples/plot x 5 plots = 45 samples; locations on map) Each soil sample was the composite of 3 cores taken 1 foot apart. Conditions were not good for fumigation in the fall of 1977; therefore, another attempt will be in the spring of 1978. Pre-and postfumigation samples will be taken at that time using this same sampling scheme. Only the 5 plots indicated will be fumigated, and the entire area covered by the map will be sowed with ponderosa pine.

The 45 soil samples were each diluted in water agar and spread on petri dishes with selective media for growing Pythium [1/] and Fusarium [2/]. The colonies of fungi on the plates were counted and the propagules per gram of soil calculated. Soil for the Pythium analysis had 12% moisture; soil for the Fusarium analysis was air-dried.

1/ Hendrix, F. F., Jr. and E. G. Kuhlman. 1965. Factors affecting direct recovery of *Phytophthora cinnamomi* from soil. Phytopathology 55:1183-1187.

2/ Nash, S. M., and W. C. Snyder. 1962. Quantitative estimations by plate counts of propagules of the bean root rot Fusarium in field soils. Phytopathology 52:567-572.

RESULTS

The results of propagules per gram of soil counts for Pythium are presented in Table 1; the results for Fusarium are in Table 2. Both Pythium and Fusarium showed significantly more propagules per gram of soil at the top 2 sampling levels (A and B) than at the lower level (C).

A composite sample of the top 15 cm of soil in all 5 plots was sent to Agricultural Consultants Laboratory in Brighton, Colorado for a general analysis. The results are presented in Table 3.

DISCUSSION AND CONCLUSIONS

No extensive soil samples to determine population levels of *Pythium* spp. and *Fusarium* spp. have been analyzed previously from Big Sioux Conifer Nursery; therefore, the relationship between levels of soil fungi and seedling survival is unknown at this time. The numbers of Pythium propagules obtained by our procedure would indicate fairly high levels of the fungus when compared to analyses conducted in several Oregon nurseries where seedling damage information is available. [3/] Conditions at the Big Sioux Nursery are different, and we do not suggest control measures such as fumigation are necessary until more information is available.

The propagules per gram of soil counts we obtained are an estimate of the number of pathogenic fungal propagules in the soil; also, they represent only the species that grow on a selective culture media. Other selective media would give different counts, but as long as the same procedure is used for each test and the counts are related to seedling survival, they are useful. We plan to take more soil samples in the spring of 1978, hopefully before and after fumigation with Dowfume® MC-2 to evaluate its effect in 1) reducing the population levels of Pythium and Fusarium and 2) affecting ponderosa pine seedling production.

3/ Johnson, D. W. and B. Zak. 1977. Effects of soil treatments on fungal populations and ponderosa pine seedling survival in an Oregon nursery. Plant Dis. Reptr. 61:43-47.

TABLE 1

PYTHIUM - propagules per gram of soil

Depth of soil sample (cm)	Plot 1 [1]	Plot 2	Plot 3	Plot 4	Plot 5	Mean [2]
A (0 - 5)	109	107	96	95	96	101 [a]
B (12.5 - 17.5)	94	131	106	112	110	112 [a]
C (25 - 30)	38	92	44	40	44	52 [b]

[1] Each number is the average of 3 sample locations.

[2] Means followed by the same letter are not significantly different at the 0.05 level (Tukey's test).

Analysis of Variance

Source	SS	df	MS	F	
Soil sample depth	30,610.34	2	15,305.17	45.43	***
Plots	6,505.52	4	1,626.38	4.83	**
Interaction	3,153.70	8	394.21	1.17	N. S.
Error	10,106.39	30	336.88		

*** Significant at 0.001 level

** Significant at 0.01 level

N.S. Not significant

TABLE 2

FUSARIUM - propagules per gram of soil (to nearest 100)

Depth of soil sample (cm)	Plot 1 [1]	Plot 2	Plot 3	Plot 4	Plot 5	Mean [2]
A (0 - 5)	4,800	4,000	3,000	2,500	2,800	3,600 a
B (12.5 - 17.5)	4,000	4,100	3,300	3,200	2,600	3,600 a
C (25 - 30)	2,300	1,300	800	900	1,300	1,300 b

[1] Each number is the average of 3 sample locations.

[2] Means followed by the same letter are not significantly different at the 0.05 level (Tukey's test).

Analysis of Variance

Source	SS	df	MS	F	
Soil sample depth	50,769,683.20	2	25,384,841.60	16.38	***
Plots	13,303,611.02	4	3,325,902.76	2.14	*
Interaction	579,827.99	8	579,827.99	0.37	N. S.
Error	46,489,542.67	30	1,549,651.42		

*** Significant at 0.001 level

* Significant at 0.10 level

N.S. Not significant

TABLE 3

SOIL TEST - BIG SIOUX CONIFER NURSERY

September 1977 - top 15 cm of soil in Plots 1 - 5

General Analysis

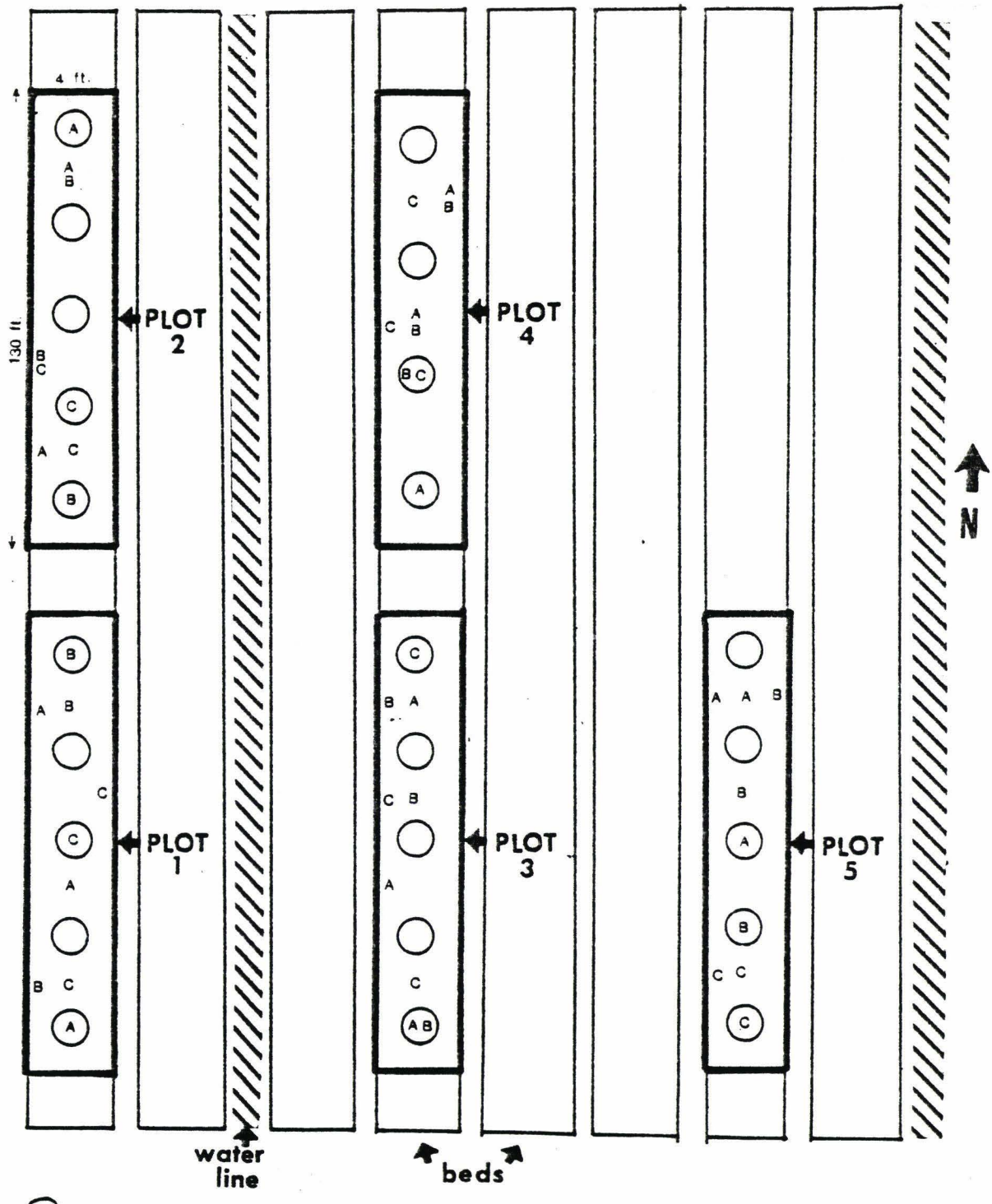
Texture	silty loam
pH	7.0 (neutral)
SALT (Mmhos/cm)	0.9
Sodium	0.4
Lime %	0.0
Organic Nitrogen (lb/acre)	75

Available nutrients (parts per million)

NO_3 (nitrate nitrogen)	19
P (P x 2.3 = P_2O_5)	65
K (K x 1.2 = K_2O)	150
Ca	2,100
Mg	480
S (S x 3 = SO_4)	31
B	0.4
Zn	1.7
Fe	22.0
Mn	7.0
Cu	0.5

BIG SIOUX CONIFER NURSERY

map of soil sample locations



◯ = future locations of fumigant cans

Letters A, B, and C are locations of soil samples
- A = 0-5 cm deep
- B = 12.5-17.5 cm deep
- C = 25-30 cm deep

PESTICIDE USE STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key -- out of the reach of children and animals -- and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.